Zero Retries issue 0007 2021-08-27

Advanced Amateur Radio - Data Comms; Space; Microwave… the fun stuff!
Nothing great has ever been accomplished without irrational exuberance. - Tom Evslin.
Irrational exuberance is pretty much the business model of Zero Retries - **Steve Stroh N8GNJ**

Steve Stroh N8GNJ, Editor

Jack Stroh, Late Night Assistant Editor

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Introduction to New Paradigm Network Amateur Radios

In Zero Retries 0004 - VARA FM Deep Dive, I said:

> For a long time I have hoped that if only we could get a "new paradigm" Packet Radio system like the late, lamented largely software-defined UDRX-440 Universal Digital Radio we could have have advanced features for Amateur Radio Data Communications like [list of features].

I concluded that section with:

> We never got it… and probably won't, at least in the form of a radio like the UDRX-440 and the complete feature set I describe. Maybe we *could*, if someone

> or (preferably a team) who are capable about such radio technology could put together such a project similar to what the M-17 Project has done, funded by a grant from ARDC.

Maybe, if I described the potential for such a radio that I see, and some ways it could be accomplished, perhaps *someone* in Amateur Radio with vision, talent, resources, and most of all, stamina saw these descriptions, then perhaps such a radio could be brought to life.

So with that hope in mind, I'm going to go out on a bunch of limbs here, describing what I see as a number of different possibilities for a "New Paradigm Network Amateur Radio (NPNAR)". This issue is Part 1 of at least 3 parts.

In describing these potential radios (systems) I make a somewhat artificial demarcation between the "host computer" and the "New Paradigm Network Amateur Radio". In reality (and in commercial practice) the "host computer" is part of the "Radio" and all that comes out of the Ethernet or USB port is data. That's certainly possible to do with the "New Paradigm Network Amateur Radio", but it seems desirable for Amateur Radio use to split the functions out to incorporate a host computer because it simplifies (somewhat) and cost-reduces (somewhat) the design of the radio to assume a host computer. It also makes it easier to experiment - need more processor power for a new mode? Get a faster host computer.

"Network" is in the name because the radio I envision is going to be an appliance such as a Digital Subscriber Line (DSL) modem or cable modem. That is, its job will be to just move the bits from Ethernet (or USB) back and forth to RF, with as little overhead and processing as possible. As much as possible, the "heavy lifting" of protocols, modulation, decoding, etc. are shunted off to a generic, powerful computer, perhaps a Raspberry Pi, being ubiquitous, inexpensive, and powerful (Raspberry Pi 4).

Software Defined Transceivers for HF - Solved Problem

In my admittedly biased opinion (I'm not much of an HF operator… though that will probably change in the coming months), Software Defined Transceivers for High Frequency (loosely defined in Amateur Radio as frequencies below 50 MHz) are good enough.

For a minimalist, low-power Software Defined transceiver for HF, there is the remarkable (to me) RadioBerry V2.0 - A HF Radio HAT for Raspberry Pi computers. There are a lot of minimalist Software Defined HF transceivers, including units like the HF Signals μBitx that use microcontrollers for much of the "Software", but the RadioBerry strikes me as the most elegant example. (I've got to get one on order.)

On the high end of Software Defined transceivers for HF, in my opinion there's nothing else that's comparable to the Flex Radio 6000 series of HF radios and accessories. From the original SDR-1000, Flex Radio units were designed from the ground up to harness the power of external computers. When I finally decide to buy a high-end HF radio system, it will be a Flex Radio product, because Flex Radio is *all in* on Software Defined Radio technology like Tesla is all in on battery electric vehicles. (The comparison is *not* casual.)

In between those two extremes of Software Defined transceivers for HF, there's near infinite choice of features, sophistication, price points, capabilities, and use cases. Thus, in my mind,

Amateur Radio Software Defined Transceivers for HF is a Solved Problem - just pick the one that best suits your particular requirements and preferences. Thus… there isn't much to talk about for future development - experimentation and evolution is well underway. Data modes for HF are easily experimented with because of the restricted radio channels and audio spectrum available on HF, thus even modest audio interfaces and computers can be used for data modes on HF.

However, on VHF and UHF, there is nothing (I'm aware of) resembling the Flex Radio 6000 series, or even the RadioBerry.

In the original version of this article, I *was* going make light of the suggestion from a friend to use a >$3000 Flex 6000 series radio as a NPNAR - "just add transverters" (yuk yuk). But, after watching one of the presentations of the QSO Today Virtual Ham Expo with Flex Radio's Chief Technical Officer (CTO) Steve Hicks N5AC, it became obvious that "just add transverters" isn't a casual add on. The use of transverters with the Flex 6000 series is a carefully considered integral feature of the Flex 6000 series. For example, there is a lot of input / output available in a Flex 6000 to key up various external units in proper sequence. There's also the ability to adjust the frequency display from the native HF frequencies (up to 54 MHz) of the Flex 6000 series to reflect the transverted frequencies (up to 999 GHz). Turns out N5AC is a microwave enthusiast, and had no problem getting Flex Radio to embrace microwave operation. Thus, if you can afford it, there's a lot to recommend a Flex Radio 6000 series radio with transporters as a NPNAR.

The Icom IC-9700 Doesn't Make The Cut (for a NPNAR)

To answer some feedback that would surely result, if I didn't proactively discuss it, unfortunately, the Icom IC-9700, which covers 144-148 MHz, 440-450 MHz, and 1240-1300 MHz doesn't make (my arbitrary) cut as a New Paradigm Network Amateur Radio because limitations of its built-in audio interface preclude high-speed modes such as 9600 bps FSK Packet Radio, and likely VARA FM. Unfortunately, the built-in audio interface is so deeply embedded, there's apparently no access to "flat audio" in the IC-9700, so IC-9700 users are "stuck" with the limitations of the built-in audio interface.

However, in fairness to Icom and the IC-9700's designers, kudos for including Icom's D-Star "Digital Data (DD)" mode that does 128 kbps data in 1240-1300 MHz. This mode was first implemented in the discontinued Icom ID-1. DD mode is still the fastest data communications available for Amateur Radio bands that's available in an off-the-shelf Amateur Radio device. Also, if memory serves, the IC-9700 is the only off-the-shelf Amateur Radio for VHF and UHF with a built-in Ethernet port for data input / output. Kudos for that also.

Also in fairness, from reports I've read, the IC-9700 is a great radio for working many Amateur Radio satellites (the "9600 bps FSK issue" notwithstanding).

Why Focus on VHF and UHF?

- **Speed** - It's possible to do Megabits per second on Amateur Radio VHF and UHF

spectrum. *Yes, really!* It's not widely known, but there was, briefly, a product from Doodle Labs - the DL435-30 that transverted a Wi-Fi chipset to 420-450 MHz with 5 or 10 MHz channels.

- **Space (Spectrum)** - 50-54 MHz, 144-148 MHz, 222-225 MHz1, 420-4502, and 1240-1300 MHz. The latter two are fertile areas for higher speed data communications experimentation. Especially 1240-1300 MHz where 100 kHz channels are "easy". The Icom ID-1 (and now the Icom IC-9700) can do 128 kbps on a 100 kHz channel using Icom's D-Star Digital Data (DD) mode. That's a good start. New Packet Radio can do 500 kbps in a 100 kHz channel.

- **Space (Channel Time)** - If you haven't noticed, there actually isn't nearly as much activity on our Amateur Radio VHF and UHF bands as there used to be a decade or so ago. One reason is that we don't need autopatch any more. An increase in usage for higher speed data on VHF and UHF really isn't going to bother very many people.

- **Localized** - VHF and UHF spectrum can "punch through" trees and penetrate reasonably well into buildings. This contrasts with the 2.3 GHz, and especially 5.9 GHz (microwave) Amateur Radio bands. We can generate reasonable power on VHF and UHF - even hundreds of watts for specialized uses such as Earth Moon Earth (Moonbounce).

- **Easier Antennas** - Antennas at VHF and UHF are manageable, especially for those in condominiums and apartments.

- **Repeaters / Digipeaters** - VHF and UHF spectrum is amenable for construction and use of repeaters and digipeaters on high locations such as buildings and mountaintops. This makes it much easier for users to use lower-powered radios with constrained antennas.

Use It, or Lose It. Really! The primary reason that we need New Paradigm Network Amateur Radios is because if we don't start making reasonable use of our Amateur Radio VHF and UHF bands, we will lose them because it will be provable that we're simply not using them. Surely experimenting with higher speed data communications on Amateur Radio VHF and UHF bands is better than losing them to commercial services from lack of use. For those new to Amateur Radio, this isn't a theoretical threat - it's happened before. As mentioned in this FCC document:

> In August of 1988, the Commission adopted its Report and Order in Docket 87-14, which was affirmed in June of 1989, reallocating the 220-222 MHz band from the Amateur Radio Service to the land mobile radio services.

Let's get those computers to work communicating at higher speed on our Amateur Radio VHF and UHF bands!

Software Defined Receivers… *We Got!*
The Low Hanging Fruit

One key point in creating a NPNAR is that half the job *is complete!* We already *have* highly capable, reasonably priced receivers such as:

- Airspy R2 - any contiguous 10 MHz within 24 MHz through 1.7 GHz
- RTL-SDR Blog RTL2832U (v3) - any contiguous 2.4 MHz within 500 kHz through 1.766 GHz
- SDRplay RSP1A, RSPdx, and RSPduo - any contiguous 10 MHz within 1 kHz through 2 GHz

Thus if we're starting from scratch to create an NPNAR, let's not complicate the design by recreating the part we already have off-the-shelf (unless the receiver is essentially "free", as in it would be more complicated and more expensive *to take the receiver function out* of an NPNAR, such as the software defined transceivers in the next section).

I/Q Radios

I'll define an I/Q Radio, *horribly* imperfectly, as a radio that is basically a big A/D and D/A converter. For receive, an I/Q Radio digitizes the RF signal (or portion of it that's of interest) and spits out I/Q data to the computer. To transmit, the computer synthesizes I/Q data and sends it to the radio. All the "heavy lifting" in creating the radio waveform is done by the computer.

In researching "IQ radios", I quickly discovered why this idea seemed so familiar - it's an old vision of a group I was part of in the Seattle area. I wrote this article in the TAPR Packet Status Register Issue 0083 in Spring, 2002 (page 10-14). Here are the first few paragraphs:

> **The Seattle Software Radio by Steve Stroh, N8GNJ**
> The group of Amateur Radio Operators in the Seattle, Washington area that I call the "Puget Sound Amateur Radio TCP/IP Group" (many prefer to call it the WetNET Group") operate four (currently - several more are in work or conversion) 9600-baud bit regenerative repeaters in the Seattle area. The repeaters are on various bands - three are on UHF, one on 222 MHz that may eventually be converted to 9600 baud, and on 2m.
>
> For this reason, the group as a whole has an ongoing interest in 9600-baud capability and at least one of each new radio claiming 9600-baud capability is purchased by someone in the extended group. The year of 2001 saw the introduction of a new line of radios (manufacturer deliberately left unspecified) with 9600-baud capability. We were severely disappointed with this line of radios due to their excessively long RX/TX turnaround time.
>
> Ken Koster, N7IPB, and Dennis Rosenauer, AC7FT/VE7BPE, two of the most knowledgeable members of the group began speculating about what it would take to design a 9600-baud data radio that would work well. Of course, this opened the floodgates - 9600 baud is too slow to bother, cheap should be the goal, why not add additional features like Forward Error Correction, etc.
>
> The discussion devolved (good humouredly) from there... but then reconvened after the ideas had been allowed to digest for a week or so.
>
> What ended up being proposed was a data-oriented Software Defined Radio (SDR)

that would use a PC to handle the Digital Signal Processing (DSP) and Networking / Protocol chores

Linux PC* <— —> Ethernet <— —> Radio

The RF portion would be minimal; a basic radio front end and Digital to Analog (D/A) and Analog to Digital (A/D) conversion resulting in I and Q signals. The A/D and D/A stages of the radio would be managed by a micro controller, which would communicate with the PC over Ethernet, likely sending and receiving User Datagram Protocol (UDP) packets.

The inspiration to this approach was the phenomenal success of Amateur Radio DSP development being done with PC sound cards. However, it was felt that this approach was limited in how much could be accomplished due to the limited nature of the sound card hardware.

Software Defined Transceivers… *We Got Those Too!*
More Low Hanging Fruit

Fast forward a mere nineteen years. As with Software Defined Receivers, we actually already *have* highly capable, reasonably priced Software Defined *Transceivers* such as:

- Analog Devices ADALM-Pluto - any contiguous 20 MHz within 325 MHz through 3.5 GHz. I'm in awe of this device. I wrote an (deep dive) article on it on my SuperPacket Blog - and have a reference page about it on my SuperPacket blog - New Page - Analog Devices ADALM-PLUTO - Reference and the actual web page - Analog Devices ADALM-PLUTO - Reference.

- Great Scott Gadgets HackRF One - any contiguous 20 MHz within 1 MHz through 6 GHz

- Lime microsystems LimeSDR Mini - any contiguous 30 MHz within 10 MHz through 3.5 GHz

- Nuand bladeRF 2.0 micro xA4 - any contiguous 61 MHz (?) with 47 MHz through 6 GHz (probably a bit overkill for Amateur Radio use)

The problem with the above units is that the transmit power is very low, and there are potentially out-of-band emission issues. These aren't *quite* radios, they're "test equipment". Most of them operate directly off USB power, so it's asking too much for reasonable transmit power levels. Thus, we need some additional hardware for more than "benchtop" range between units. For example, LimeRFE increases transmit power levels for the LimeSDR Mini up to 1 watt or so… for $549.

Casually, you'd think "just add a power amplifier". That's a reasonable assumption until you realize that typical Amateur Radio power amplifiers such as the Toptek Communications PA-80U - $260 from DX Engineering (mentioned here purely as a real world reference) require a minimum drive level of 3 watts.

Thus, there's a missing piece between Software Defined Transceivers and usability in Amateur Radio, called a "Driver Amplifier". The best reference I could find about this issue is an August 29, 2020 article in Hackaday - SDR TRANSMITTING GETS THE POWER that links to the Tech Minds YouTube channel - who is Matthew Miller M0DQW. Just from that one YouTube video, I'm impressed enough to now be a subscriber.

So, it seems that anyone who is looking for an untapped Amateur Radio hardware niche, there's a gaping hole for a simple power amplifier(s) with these specifications:

- Input drive level of 10 mW or so will drive the amplifier to its full power (compatible with the transmit power output of ADALM Pluto, HackRF One, and LimeSDR Mini as those are the most popular Software Defined Transmitters in current use).
- Output level of 3 watts or 5 watts (that seems the minimum to drive off-the-shelf power amplifiers).
- Simple band pass filter network (suppress out-of-band emissions).
- Versions for 50-54 MHz, 144-148 MHz, 222-225 MHz, and 440-450 MHz (and, ideally, 420-430 MHz and 430-440 MHz), and 1240-1300 MHz.
- Comes with a heatsink (I'd rather pay more for a proper heatsink than having to scrounge one on my own).

Some "nice to have" features (but not worth significant additional expense):

- Mounting tabs so that it can be incorporated into a package (it will be in between a Software Defined Transmitter and a power amplifier).
- Operates directly from 12 volts DC would be nice (but not critical).
- Push to Talk (PTT) input (for experimentation, carrier sense may be adequate, but it would be nice to to have a PTT input).

Amazon / eBay / Alibaba… Yes, I'm aware of all of these "amplifiers" available from these vendors. Some of my favorite phrases from the product descriptions, that illustrate my caution, are "Well-design", "Application Widely", and most reassuring ***"Our products have quality assurance"****. My main concern is that even if you buy one of these, and it works, there's no guarantee that if you buy exactly the same unit again, from the same vendor, that you'll get the same thing. 'Nuff said.*

Mini-Kits (Australia) gets the idea with a brief mention of their PLUTO-CHARON 70/23cm Module. Unfortunately, it's not yet a product, and when it is a product, it will be a kit with numerous surface mount parts.

There's a niche to be exploited in someone taking the time to buy samples and qualify the various "amplifiers" from Amazon / eBay / Alibaba and resell them as tested-for-purpose for Amateur Radio. I'd happily pay a premium for such a service instead of the "treasure hunt" buy / test / attempt-to-return nature of buying from Amazon / eBay / Alibaba.

If you can create such a device, but don't want the overhead of ordering parts, building, stocking, fulfillment, etc., check out Crowd Supply.

Caveat - having encouraged someone to tackle this "untapped Amateur Radio hardware niche", it's only fair to recite the canonical advice about the best way to make a small fortune in the Amateur Radio market…
Start with a ***large*** fortune. (You've been warned.)

Two words about Software Defined Radios - GNU Radio

Of course, a Software Defined Receiver, or Transceiver takes care of the hardware end of things. You still need the Software part of "Software Defined…". For that, there's the amazing GNU Radio Software Toolkit. I tell the story of my epiphany about GNU Radio on my SuperPacket blog pretty well in an article - New Page - Analog Devices ADALM-PLUTO - Reference, so I'll just excerpt the portions about GNU Radio below.

> I got my Amateur Radio license in 1985, primarily to experiment with data communications over VHF / UHF Amateur Radio. At that time, Packet Radio in Amateur Radio was becoming a very big deal; for a time it kind of dominated Amateur Radio.
>
> In *very* simplistic terms, data communications over Amateur Radio is actually a fluid exchange of bits between four distinct elements:
>
> - The radio - the piece of equipment which takes a baseband input (usually audio) and translating that signal into a radio frequency signal. Typically (but not an absolute given) the radio usually includes the reverse process - receiving a radio frequency signal and translating it into a baseband signal.
> - The CODEC or MODEM - as we know them in 2021, radios are usually set up for analog (audio) input and output on the baseband (non-RF) side so you need a device that takes digital data that you want to transmit and codes and decodes that data. That function is sometimes called a CODEC (Coder / Decoder) or a Modem (Modulator / Demodulator).
> - The Protocol Engine - The modem just handles the analog to digital to analog chore. The protocol engine is in charge of encoding the bits so they'll survive the rough journey over the air, where there is interference, fading, and other hazards. The protocol engine arranges the bits "around" the actual data. One example is adding a callsign identifier.
> - The Applications - I'm vastly simplifying this element but basically once the protocol engine does its job, it hands the data (stripped of all the protocol engine bits) over to the application. One example of an application is email.
>
> I said "fluid exchange" because the needed functionality can drift back and forth between the various elements, depending on who is actually making the elements. For example, the venerable Kenwood TM-D710GA is a pretty capable radio with a built-in modem (1200 bps AFSK and 9600 bps FSK).

Those of us that just want to play with data, like send email over Amateur Radio, would love for all of the above to be packaged up into an inexpensive appliance. Kind of like a laptop with Wi-Fi, only it works over the long(er) distances that we've come to expect with Amateur Radio VHF/UHF communications. And unlike the black box that is Wi-Fi embedded into a laptop, we do want to play at least a little bit.

In 2021, we're not there yet. By mid-decade, we might be if certain technology trends keep going the right way, like the way we keep getting better and better Raspberry Pi computers for the same $35 over the years.

Given the desire for the "data communications over Amateur Radio appliance" described above, I keep hoping. We got close, briefly, a few years ago in the Northwest Digital Radio UDRX-440 project. I told some of the story about why the UDRX-440 didn't quite make it to becoming a finished product in a previous article - Amateur Radio Digital Communications (aka ampr.org / 44net).

The bigger problem than that what the stillbirth of the UDRX-440 represented, is that Amateur Radio is just a maddeningly small market for a manufacturer to actually create, ship, and support a viable product. (Not to mention Amateur Radio being a market that is maddeningly price sensitive.) What we all want to do with our "inexpensive Amateur Radio data communications appliance" varies widely.

Thus, when I've (unwisely) voiced my quest for said appliance over the years to several people that are way smarter than me, they've given me an answer that, at first blush, was irritatingly simplistic:

GNU Radio is the answer... what was the question?

Irritating to me because GNU Radio is simultaneously an incredibly capable software package, and a near-infinite time sink when one (like me) just wants to *do* data communications (appliance style) and spend most of your time actually communicating data over the air.

Doubly irritating because, in the end, I've come to understand (and admit) that *they're right*. The fantasy Amateur Radio data communications appliance (such as the UDRX-440) simply isn't a viable product in a market as small and as price sensitive as Amateur Radio. So they're way ahead of me in recommending GNU Radio to me because anything one wants to experiment with in Amateur Radio data communications is probably *already in GNU Radio*.

…

One more bit on the quest for an Amateur Radio Data Communication Appliance - while the ADALM-PLUTO will definitely use GNU Radio... it *doesn't have to use GNU Radio*. IE, you don't have to constantly be in "experimentation" mode with it. Once you have it doing what you want it to be doing, it will keep doing that (IE, appliance mode)... until you decide to change it. Thus, like a lot of other projects, once you have a successful "recipe" for it, you can clone that setup, your friends

can benefit from your work, and you can spend your time communicating.

Fun fact - GNU Radio is now 20 years old - it debuted in 2001.

The Complete *Software Defined* New Paradigm Network Amateur Radio

Even though it makes total sense to me to have a Defined Transmitter (just the transmitter, not a Transceiver), I'm unaware of any in existence. So, I'll focus on using Software Defined Transceivers in the thought experiment below. The parts necessary for a Software Defined New Paradigm Network Amateur Radio are:

- Host computer (probably best that it be dedicated). The more powerful, the better. It may well not be overkill to get a surplus rack mount server with a lot of RAM and multiple 1 Gbps Ethernet and USB 3 interfaces.
- Software Defined Transceiver (SDT)
- "Driver amplifier" (some units available, but need a purpose-built unit)
- Bandpass filter
- Power amplifier
- Feedline, antenna
- GNU Radio software suitable for the chosen SDT
- GNU Radio Companion (GRC) software
- Lots, and *LOTS*, and ***LOTS*** of patience.

My wild guess is that the cost of the above collection of hardware ranges from $500 - $1000 depending on which components are chosen. For example, good power amplifiers for 144-148 MHz are available for <$200, but good power amplifiers for 440-450 MHz seem to be ~$500.

Feedback, *Please!*

I'll guess that someone *is already doing* what I'm describing as a Software Defined New Paradigm Network Amateur Radio. If you've heard of such a project, especially a group of people doing such a project, please let me know.

Also I'll guess that the "Driver Amplifier" I posit *probably already exists*… I just couldn't find it in my research for this article. If you know of something like what I described, please let me know that also.

Request To Send

The dreaded Orange ***Near Email Length Limit (!)*** has appeared, telling me that once again I had too much fun creating content for Zero Retries. And, make no mistake, creating Zero Retries, and sharing it with you readers, *is fun*!

I'll continue the discussion of New Paradigm Network Amateur Radios in Zero Retries 0009 (unless another topic comes up that seems more urgent). When I finally exhaust the topics that consume entire issues of Zero Retries, I'll resume writing articles about Amateur Radio In Orbit.

Feedback Loop

Redditor GDK_ATL (comment) 2021-08-04

> *ZR: Amateur Radio isn't much more socially relevant than blacksmithing is to modern manufacturing*
> Socially relevant! Who cares how socially relevant it is? Fly fishing, golf, knitting, softball, ping pong, biking, running, curling, gymnastics, swimming, and on and on, how socially relevant are those? Maybe too many people just want a hobby that facilitates their virtue signaling on social media.

GTK_ATL - The *social relevance* of Amateur Radio *matters* because it uses a public resource, as in the spectrum Amateur Radio is allocated. If Amateur Radio in the US isn't socially relevant, it won't be allowed to continue to use the public resources of spectrum.

Redditor arkhnchul (same thread as above)

> author really should say "USA amateur radio" instead of just "amateur radio".

arkhnchul - You're right, now so disclaimed (see below). That said, I hope that Zero Retries eventually finds an audience outside the US, and non US Amateur Radio Operators can contribute their perspective.

John Grumling K0JEG comment on Substack regarding Zero Retries 0006

> I would add a possible full duplex repeater mode, similar to how a DOCSIS cable modem operates. Cable modems (CM) only communicate with a specialized router known as a Cable Modem Termination System (CMTS). The CMTS downstream carrier imbeds data describing how and when a CM can communicate to establish communications. This data includes transmit frequencies, modulation types supported and TDMA timing sync data.
>
> …
>
> *K0JEG includes much more detail - go to the link and scroll to the bottom of the page. Unfortunately space doesn't permit me to include his entire comment.*

K0JEG - This sounds like a fascinating area of research! I note that many HF software defined radios are using chips originally designed for cable modems. Perhaps the cable modem protocols *could* be adapted for Amateur Radio.

Closing The Channel

A commenter in Reddit pointed out that I should disclaim that the views I express in about Amateur Radio in Zero Retries are mostly about Amateur Radio in the US. That comment is correct, thus consider it disclaimed that Zero Retries has a US-centric perspective of Amateur Radio. I do my best to think of "rest of world" Amateur Radio in my writing, but I'm not there in other parts of the world, so if I say something blatantly inaccurate, please call me out.

If you're enjoying Zero Retries, please tell your friends and co-conspirators. For the immediate future, Zero Retries will remain an experiment in progress. Feedback is easy if you're reading Zero Retries in email - just hit Reply and I'll get your email. Or you can go to the web version of any Zero Retries issue, scroll to the bottom, and post a comment on the web version of a Zero Retries issue. I'm especially interested in content ideas about things that you'd like to see discussed in Zero Retries. If you know of "Zero Retries Interesting" projects, groups, activities, etc. please let me know. I do reply to every Zero Retries email I receive.

Email issues of Zero Retries are "instrumented" by Substack to gather basic statistics about opens, clicking links, etc. There is no "text only, no instrumentation" version of Zero Retries available. I don't use such information in any way other than (in the absence of much feedback) getting some satisfaction that the data shows that people actually do read Zero Retries.

All previous issues of Zero Retries are available without restriction (no paywalls). For some background on Zero Retries, Issue 0000 was The Introduction Issue.

Thanks for reading!
Steve Stroh N8GNJ
Bellingham, Washington, USA
2021-08-27
If you'd like to reuse an article in this issue, for example for club or other newsletters, just ask. Please provide credit for the content to me and any other authors.
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1

Yes, there is also 219-220 MHz, but I'm not aware of anyone who has ever implemented a system there. 219-220 MHz is a "*there be dragons*" band. But, perhaps, with a Special Temporary Authority… Deserves further thunkin' and study.

2

It's just a circumstance, but I've been "cursed" in my Amateur Radio career to live *North* of Line A, and thus, I've never been able to operate in 420-430 MHz. Darn Canadians! Line A was about 50 miles *South* of my previous home in Woodinville, Washington, and now living in Bellingham I'm only 10 miles or so South of the Canadian border, so no "fudge factor / ask for forgiveness" to use 420-430 MHz for experimentation for me.

Below is a much more complete "footer" that has evolved over 30+ issues of ZR.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, here are some pointers:

- **Ham Radio for Dummies** by Ward Silver N0AX is a great overview of Amateur Radio. N0AX is a gifted writer and HRFD is now in its 4th edition.
- My two favorite **YouTube** channels for a good overview of Amateur Radio are AmateurLogic.TV. and Ham Nation (part of Ham Radio Crash Course). These folks just seem to have so much fun!
- Radio Amateur Training Planning and Activities Committee (**RATPAC**) offers weekly presentations on general Amateur Radio topics (Wednesdays) and emergency communications in Amateur Radio (Thursdays).
- Dan Romanchik KB6NU offers a free **No-Nonsense Study Guide** for the Technician test (PDF).
- HamExam.org Amateur Radio Practice Exams offers good **Flash Card and Practice Exams**.
- When you're ready to take an **Amateur Radio examination** (Tech, General, or Extra), W1MX - The MIT Amateur Radio Society offers remote exams, free for students and youngsters. *There are apparently many other remote exam options*.

Bonus - with an Amateur Radio license, you'll be more attractive on dates 😀

Closing the Channel

- In its mission to grow Amateur Radio and make it more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex!
- My ongoing Thanks to Tina Stroh KD7WSF for, well, *everything* and Bill Vodall W7NWP as *Zero Retries Instigator in Chief*.
- My ongoing Thanks to pseudostaffers Dan Romanchik KB6NU and Jeff Davis KE9V for continuing to spot, and write about "Zero Retries Interesting" type items, on their respective blogs, from Amateur Radio and beyond, that I don't spot on my own.
- Southgate Amateur Radio News consistently surfaces "Zero Retries Interesting" stories.
- The Substack email publishing platform makes Zero Retries possible. I recommend it for publishing newsletters.

If you see something interesting mentioned in Zero Retries and would like to search all the Zero Retries "Back Issues", that's now easy - just click:

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If you're reading this issue on the web and you'd like to see Zero Retries in your email Inbox every Friday afternoon, just click:

✔

If you're a fellow smart person that uses **RSS**, there *is* an **RSS feed for Zero Retries**.

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Zero Retries on Twitter

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All previous issues of Zero Retries are available without restriction (no paywalls). For some background, Zero Retries 0000 was the **Introduction Issue**. Zero Retries 0026and Zero Retries 0027 were a **2021 Year End Review** of Zero Retries.

More bits from Steve Stroh N8GNJ:

- SuperPacket blog - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- N8GNJ blog - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ (He / Him)
These bits were handcrafted in beautiful Bellingham, Washington, USA

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